C2

therefrom wherein the amount of increase and decrease in fluid pressure is based on the amplitude of the signal.

Sub1

15. (Twice Amended) A reciprocating pump comprising:

C3

a drive system including a pair of permanent magnets and a coil assembly, the coil assembly being energizable to cause reciprocal movement of a drive member; and

a pump assembly disposed adjacent to the drive system, the pump assembly including means for admitting a supply of fluid into an inner volume of the pump assembly, means for pressurizing the inner volume by reciprocal movement of the drive member, and means for expressing pressurized fluid from the inner volume.

Please cancel claim 18.

REMARKS

Claims 1-24 are pending in the present application. In the Office Action of October 17, 2002, the Examiner reopened prosecution after Applicant filed an Appeal and Appeal Brief. For the first time, the Examiner set forth a Double Patenting Rejection based on a patent assigned to the Assignee of the present application and filed after the present case but that issued June 4, 2002. The Examiner also presented new 35 U.S.C. §102 and §103 rejections.

The Examiner also raised new objections to the drawings under 37 CFR 1.83(a). This new objection to the drawings is made despite the Examiner approving the drawings in the Office Action of March 21, 2002.

Additionally, the Examiner raised 35 U.S.C. §112, second paragraph projections, also not previously raised through the entire prosecution of the application.

The Examiner rejected claim 20 under 35 U.S.C. §112, second paragraph. Claims 1 and 8 were rejected under 35 U.S.C. §102(b) as being anticipated by Waring (USP 4,940,035). Claims 2-4, 6-7, 9-11, and 13-14 were rejected under 35 U.S.C. §102(b) as being anticipated by Waring. Claims 15, 19, and 21-24 stand rejected under 35 U.S.C. §102(b) as being anticipated by Gladden (USP 3,781,140). Claims 5 and 12 were then rejected under 35 U.S.C. §103(a) as being unpatentable over Waring. The Examiner rejected claims 16-18 under 35 U.S.C. §103(a) as being unpatentable over Gladden, in view of Waring.

Double Patenting Rejections

The Examiner rejected claims 1-7, 8-14, 15, and 15-24 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-7, 17-23, 6, and 33-42 of USP 6,398,511, respectively. USP 6,398,511 to French et al. is entitled "Fuel Injection Driver Circuit With Energy Storage Apparatus" and is assigned to Bombardier Motor Corporation of America, the Assignee of the present case. French was filed on August 18, 2000 which was approximately five months after the filing of the present application. Since the present application was filed before the French patent, the double-patenting rejection is not sustainable and Applicant respectfully requests the rejection be withdrawn. Even if Applicant provided a terminal disclaimer, it would have no effect since there is no term of the present application that could extend beyond that of the cited reference. As such, Applicant respectfully requests withdrawal of the double patenting rejections.

Further, Applicant believes that the amendments set forth above are such that the claims of the present application are not obvious in view of the claims of the French patent. Specifically, elements now called for in the present claims (i.e., control signal with variable

amplitude (claims 1 and 8), a pair of magnets (claim 15)), are not found in the claims of the French patent.

Objection to the Drawings

The Examiner objected to the drawings under 37 CFR 1.83(a) as failing to show "a check valve biased in the open position". That is, the Examiner asserted that every feature set forth in claim 20 is not shown in the drawings. Claim 20 further defines the means for admitting a supply of fluid into an inner volume of the pump assembly as including a check valve biased into an open position and closed by an increase in pressure within the inner volume during operation. Applicant agrees that 37 CFR 1.83(a) dictates that a drawing in a non-provisional application must show every feature of the invention specified in the claims. However, §1.83 further provides that "conventional features disclosed in the description in claims, where the detailed description is not essential for a proper understanding of the invention, should be illustrated in the drawings in the form of a graphical drawing symbol or a labeled representation." Essentially, this provision provides that conventional features that would be understood by one skilled in the art may be shown generally in the drawings. Turning to Figs. 2 and 3 of this application, the inlet check valve is generally referenced at 154. In fact, in the corresponding description of the check valve on pages 8 and 9 of this application, Applicant states that the inlet check valve assembly is indicated "generally at reference numeral 154". Specification, P. 9, ln. 1. As such, Applicant respectfully believes that the drawings satisfy 37 CFR 1.83(a). Withdrawal of the objection to the drawings is therefore requested.

35 U.S.C. §112 Rejections

The Examiner rejected claim 20 under 35 U.S.C. §112, second paragraph, as being indefinite. Specifically, the Examiner asserted that "a check valve biased into an open position"

lacks antecedent basis. The Examiner concluded that the limitations of claim 20 are indefinite because the Examiner considered the check valve biased into an open position not to be shown in the figures. Responsive thereto, Applicant respectfully refers and incorporates herein the remarks set forth above with respect to the objection to the drawings for failing to show each element of claim 20. Additionally, Applicant believes the specification provides sufficient description to enable one skilled in the art to make and/or use that which is called for in claim 20.

In the last paragraph on page 8 and continuing onto page 9 of the Specification, Applicant describes a check valve assembly provided between a passage and pump chamber wherein the check valve is closed by pressure created within the pump chamber during a pumping stroke of the device. This description clearly sets forth that the check valve is forced to a closed position by pressure created within the pump during a pumping stroke. Moreover, one skilled in the art would reasonably infer that the check valve must be biased in an open position if the check valve is closed by subsequent action. That is, the application describes a "closing" of the check valve rather than an "opening" of the check valve.

Further, the pump and nozzle assembly is described and shown in Fig. 3 as being in an actuated position. Included is description relating to the closing of the check valve. Specifically, the specification provides that "further downward movement of the plunger and valve member begin to compress fluid within pump chamber 148, closing inlet check valve 154." P. 10, ln. 17. Accordingly, an actuation of the pump results in a closing of the check valve. One skilled in the art would clearly recognize that the opposite also occurs when the pump and nozzle assembly are not actuated. Simply, when the pump and nozzle assembly are not actuated or, more precisely, are not in an actuated position, the inlet check valve is in an open position. It is the subsequent actuation of the pump and nozzle assembly that causes closing of the check valve.

Further support of a check valve biased in an open position in accordance with the present invention is provided at the end of the first paragraph of page 11. Specifically, "pressure is reduced within pump chamber 148 to permit inlet check valve 154 to reopen for introduction of fluid for a subsequent pumping cycle." The inlet check valve returns to an open position at the beginning of each pumping cycle. Clearly, the description of the events surrounding the "reopening" of the inlet check valve provides support for that which is called for in claim 20 — a check valve biased in an opened position. As such, Applicant respectfully believes that claim 20 satisfies the statutory requirements of 35 U.S.C. §112.

35 U.S.C. §102 Rejections

Claims 1 and 8 stand rejected under 35 U.S.C. §102(b) as being anticipated by Waring. Waring teaches a fuel pump for delivering fuel over a range of flow rates to an internal combustion engine. The pump taught by Waring is electromagnetically operated such that pistons are controlled to provide metered fuel to an internal combustion engine. Specifically, Waring teaches a pair of pistons that will be caused to reciprocate when coils of an electromagnetic driving means are energized with alternating currents of a similar phase and frequency. Waring further teaches that the rate of delivery of fuel may be varied by varying the phase of operation of the piston delivery mechanisms relative to one another. Col. 4, lns. 42-48. Waring further describes the pistons as being caused to operate with a phase relationship varying from in opposition to one another to in unison to one another to deliver fuel between a minimum and a maximum delivery rate. Col. 4, lns. 61-65. Waring teaches "the phase of operation of the two pistons/cylinder mechanisms may be controlled by controlling the relative phases of the same frequency, alternating polarity electrical driving currents to the moving coil driving means for each piston. Col. 4, lns. 65-68 and Col. 5, ln. 1. Waring concludes that "it is thus possible to vary the pump delivery rate at any instant by changing the phase relationship of

the two alternating electrical currents supplied to the moving coil driving means." Col. 5, lns. 12-15.

Waring also teaches two electrical driving current sources that generate similar frequency, preferably square wave signals for energizing the electromagnetic coils. Waring teaches that "the phase relationship between the signal sources CS_1 and CS_2 is controlled by a microprocessor MR which inputs IP from, for example, an air mass flow sensor in the engine intake system, a throttle position sensor, and an engine RPM sensor, are provided." (emphasis added) Col. 5, lns. 33—40. Waring identifies that the phase of the alternating currents may differ "by any phase angle up to 180°". (emphasis added) Col. 5, ln. 51.

Claims 1 and 8, however, have been amended to further define the reciprocating fuel pump to define the reciprocal movement of a drive assembly and drive system, respectively, as being controlled to impart a force based on the variable amplitude of alternating polarity signals. Claim 1 has been amended to define the amount of force imparted by the drive assembly as being based on the amplitude of the alternating polarity signals. Claim 8 has been amended to define the amount of increase and decrease in fluid pressure as being based on the amplitude of the signal of alternating polarity. The present invention, as defined by claims 1 and 8, includes the altering of the amplitude of control signals to provide greater or lesser force by virtue of interaction of a resulting electromagnetic field and a magnetic field of the permanent magnet in the drive section. Varying the amount of force imparted by the drive assembly by controlling the amplitude of the alternating polarity signal accommodates pressure variations.

Varying the amplitude of a control signal to control the amount of force imparted by a drive assembly is a significant and patentable distinction from the phase altering control signals taught by Waring. The signals of variable phase taught by Waring are used to control one piston relative to another to maximize or minimize the amount of fuel delivered. However, that

which is called for in claims 1 and 8 is directed to varying the amount of force imparted by a drive assembly to accommodate output pressure requirements by varying the amplitude of a control signal. The amount of pressure together with the reciprocatation speed determine the amount of fuel that is injected. As such, Applicant respectfully believes that claims 1 and 8 as amended herein are patentably distinct from that taught by the art of reference.

Additionally, with respect to the rejection of claims 2-4, 6-7, 9-11, and 13-14 under 35 U.S.C. §102(b) as being anticipated by Waring, Applicant respectfully disagrees with the conclusions reached by the Examiner. However, in light of each of the aforementioned claims depending from what is believed an otherwise allowable claim, Applicant does not believe additional remarks are necessary. Accordingly, Applicant requests allowance of claims 2-4, 6-7, 9-11, and 13-14 pursuant to the chain of dependency.

The Examiner next rejected claims 15, 19, and 21-24 under 35 U.S.C. §102(b) as being anticipated by Gladden. Responsive to this rejection, Applicant has amended claim 15 to incorporate subject matter similar to that called for in claim 18. Claim 18 was rejected under 35 U.S.C. §103(a) as being unpatentable over Gladden in view of Waring. Applicant, however, disagrees with the conclusions reached by the Examiner.

The subject matter of claim 18 further defines the permanent magnet of claim 15 as including at least two magnet elements. The Examiner, in setting forth the rejection of claim 18, asserted that Waring discloses a permanent magnet composed of at least two magnet elements. Applicant agrees that Waring may be read to teach multiple magnet elements; however, claim 15 has been amended to define the drive system as including a pair of permanent magnets. Turning to Fig. 3 of '035, it is clear that Waring does not teach more than one magnet in each piston-cylinder arrangement. Waring teaches a single magnet. Fig. 3 shows a cross-section of a generally cylindrical magnet 21. Col. 4, ln. 22. Fig. 3 only appears

to have multiple protrusions extending from a magnetic body because it is a cross-section of a cylinder. To conclude that Waring teaches more than one magnet for its drive system clearly contradicts that shown in Fig. 3. This interpretation can be analogized to an internal combustion engine.

For example, a multi-cylinder internal combustion engine such as an engine having six cylinders is considered, and commonly referred to, as a "six-cylinder engine". A structure with six cylinders is not considered to be six separate engines. The same holds true in the present case. That is, while Waring may teach multiple protrusions or portions of a magnet, nevertheless, Waring teaches only one magnet per each piston-cylinder arrangement. Accordingly, Applicant believes that claim 15, as now pending, is patentably distinct from Gladden as Gladden fails to show a pair of magnets and is deemed allowable over Gladden in combination with Waring as Waring also fails to teach a pair of magnets in a single structure.

35 U.S.C. §103 Rejections

Claims 5 and 12 as well as claims 16-18 were rejected under 35 U.S.C. §103(a). Claim 18 has been canceled in this response. Regarding the rejection of claims 5, 12, and 16-17, Applicant respectfully disagrees with the Examiner with respect to the art as applied, but in light of each of the aforementioned claims depending from what is believed an otherwise allowable claim, Applicant believes additional remarks are unnecessary and therefore requests allowance of claims 5, 12, 16, and 17 based on the chain of dependency.

Therefore, in light of the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1-17 and 19-24

Marked-up versions of the amendments made above may be found on pages 12 and 13.

An Appointment of Associate Power of Attorney together with a Change of Correspondence Address form is enclosed.

Applicant appreciates the Examiner's consideration of these Amendments and Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

Respectfully submitted,

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REVISIONS

1. (~~Once~~Twice Amended) A reciprocating fuel pump comprising:

a housing assembly including a drive section and a pump section;

a drive assembly disposed in the drive section, the drive assembly including a permanent magnet and a coil assembly having a winding and disposed within the central volume of the drive section adjacent to the permanent magnet and movable reciprocally axially along a central axis to impart a force upon application of alternating polarity signals of variable amplitude to the winding, wherein the amplitude of the signals defines an amount of the force imparted; and

a pump member secured to and movable reciprocally with the coil assembly, the pump member extending into the pump section to produce pressure variations in the pump section during reciprocal movement and in response to the imparting of the force to draw fuel into the pump section and to express fuel therefrom.

8. (~~Once~~Twice Amended) A reciprocating fuel pump comprising:

a drive system including a coil assembly and a permanent magnet, one of the coil assembly and the permanent magnet being disposed in a fixed position and the other of the coil assembly and permanent magnet being movable reciprocally ~~by application of~~responsive to alternating polarity in a signal of variable amplitude to the coil assembly, the drive system further comprising a drive member secured to and movable reciprocally with either the coil assembly or the permanent magnet; and

a pump assembly adjacent to the drive system, the drive member extending into the pump assembly for generating increases and decreases in fluid pressure within the pump assembly during reciprocal movement to draw fuel into the pump assembly and to express fuel therefrom wherein the amount of increase and decrease in fluid pressure is based on the amplitude of the signal.

15. (~~Once~~Twice Amended) A reciprocating pump comprising:

a drive system including a pair of permanent magnets and a coil assembly, the coil assembly being energizable to cause reciprocal movement of a drive member; and

a pump assembly disposed adjacent to the drive system, the pump assembly including means for admitting a supply of fluid into an inner volume of the pump assembly,

means for pressurizing the inner volume by reciprocal movement of the drive member, and means for expressing pressurized fluid from the inner volume.